

Eco Char	Vital Sign Category	Monitoring Objectives	VS Id#	Vital Sign	Monitoring Question(s)	Monitoring Method	Metrics	Vital Sign Rank (0-5)	Comments / Notes
Biotic Integrity	Marine Ecosystems	Landscape	Monitor patterns of distribution & extent of community types	M1	Coral Growth (erosion & accretion)	Is net accretion or erosion occurring? What are spatial patterns?	monitoring quadrats	coral growth and decline rates, water chemistry	2.7
				M2	Benthic Habitats	How are the distributions of benthic habitats/communities and coral/algal cover inside and immediately outside the Parks changing over time?	mapping, transects, quadrats	Rugosity, relative abundance, species diversity, indicator species	2.6
		Community	Monitor community dynamics, structure, function, and composition	M3	Benthic Marine Invertebrates and Algae Biodiversity	Are there long-term changes in composition of selected native communities?	Transects, quadrats (photo, video)	Cover by type, biomass, species diversity, relative abundance, counts	2.8
				M4	Subtidal - Hard Bottom (coral reef, colonized basalt, etc.)	Is variation within normal range? What are selected (community composition, distribution, physical structure) short- and long-term trends?	transects, quadrats (photo, video), mapping	cover by type, biomass, habitat type diversity, percent cover of species density	2.7
				M5	Subtidal - Soft Bottom (sand flat, seagrass bed)	Is variation within normal range? What are selected (community composition, distribution, physical structure) short- and long-term trends?	transects, quadrats, mapping	cover by type, biomass, habitat type diversity, percent cover of species density	2.4
		Benthic	Track community and population trends in harvested fisheries / collected species	M6	Benthic Reef Fisheries / Collected species (inverts: sea cucumbers, pololo worm, corals; etc)	What are effects (size/age cohort, demographics) of human harvest on fished or gathered species? What are the trends of trackable population parameters? If variance is observed, is it due to harvest? Is variance due to harvest levels?	Transects, quadrats	Counts, biomass, relative abundance	2.7
				M7	Benthic Marine Invertebrates and Algae	Is population variation within normal range (size/age cohort, demographics)? What are population trends?	transects, quadrats (photo, video), mapping	Counts, demographics, biomass, relative abundance, recruitment rate	2.7
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species	M8	Coral Growth/Size and Age Structure, and Recruitment	Is variation within normal range (growth, size, and age structure)? What are selected short- and long-term trends?	transects, quadrats (photo, video), mapping	Cover by type, growth rates, recruitment rates, mortality, survivorship	2.6
				M9	Established Coral Disease & Pathogens (including bleaching)	What is the incidence and level of disease in populations? Are diseases/pathogens affecting populations? What are trends in disease/pathogen?	transects, quadrats (photo, video), mapping, incidence	disease types, disease rates, occurrence, vectors, water quality	2.4
		Population	Monitor disease incidence and impacts, especially on native species	M10	Alien Incipient Coral Disease & Pathogens	Where are disease locations outside parks? What species are they affecting? What are rates and directions of spread? Identify existing disease/pathogen incidence, impact, and trends	Transects, quadrats (photo, video), mapping, incidence, modeling	Disease rates, occurrence, vectors, recruitment rates	2.5
				M11	Established Alien Species - Benthic Marine	Can we detect changing trends in alien and invasive species? What are effects of alien and invasive species on communities? What is response to treatment?	Transects, quadrats (photo, video), mapping	abundance, demography, distribution	2.7
			Monitor occurrence of non-established (incipient) invasive species	M12	Alien Incipient Invasives - Benthic Marine	Is species present, if so what is the nature and extent of infestation? What are the most effective strategies for detecting and preventing new invasives species? Where should efforts be focused? What are potential impacts?	transects, quadrats, mapping	abundance, demography, distribution	2.8

Intro, Monitoring goals & objectives, Conceptual Models, and Vital Signs

Also use main handout of review materials (http://www.nature.nps.gov/im/units/pacn/monitoring/plan/vs04/review_materials.htm)

Ecological Characteristic	Vital Sign Category		Monitoring Objectives
Human activities & cultural practices	Soundscapes		Monitor sound sources, frequencies, occurrence, and levels
	Viewscapes / Lightscapes		Monitor landscape / seascape appearance Monitor light levels and characteristics of light/dark cycles
	Land Use		Monitor points of entry for invasive species Monitor water use adjacent to or upstream from park boundaries Monitor land use adjacent to, or upstream of, park boundaries
	Park Use & Activities		Monitor debris-trash occurrence in coastal, riparian, wetland, and lacustrine habitats; in or near high use areas Monitor patterns of park visitation, use & damage (terrestrial & marine) Monitor incidence & occurrence of bioprospecting
	Management Zones		Monitor levels of take & harvest of harvested species (marine, freshwater, and terrestrial) or resources (coral, sand) Monitor patterns and effects of use and management Monitor effects of management practices on wilderness character
			Monitor visibility Track rates of atmospheric deposition Track atmospheric concentrations of particulates and gases, levels of radiation--emphasizing those with known human health or environmental impacts Monitor core weather/climate conditions within each park (on each island) Monitor frequency and intensity (severity) of extreme events (hurricanes, waves, winds, rain, etc.) Identify and monitor spatial patterns of climate, such as trade-wind inversion elevation, lifting condensation level, lapse rates, etc.
Physical / Chemical Environment	Climate & Air Quality		Monitor physical ocean dynamics--ocean currents, sea level, tides/swell Monitor cycles of nutrients and elements within soils and water--including carbonate (oceanic), nitrogen, and phosphorous Monitor soil erosion Monitor soil quality trends (physical, toxics/contaminants, other biologic and nutrients) Monitor condition and extent of soil crusts Monitor trends in surface water flow regimes Monitor wetland (incl. anchialine ponds) water flow exchange dynamics, size, and distribution Monitor ground water flow rates and direction of movement (recharge)
	Soil, Water, & Nutrient Dynamics		Monitor water quality core parameters Monitor supplemental water quality parameters Monitor microbiological water quality parameters Monitor toxic and contaminant levels in water Monitor biological invertebrate communities
	Water Quality		Monitor surface volcanic activity (lava flows, eruption events & ground deformation) Monitor volcanic & non-volcanic seismicity Monitor extent, location, and causes of mass wasting events (e.g. landslides)
	Geology	Hazards	Monitor shoreline dynamics Track dune locations and topography Identify and monitor the extent of permafrost Monitor karst and non-karst cave and lava tube habitat characteristics, topography, and extent
		Landforms	
Biotic Integrity	Terrestrial Ecosystems	Vegetation	Monitor patterns of distribution & extent of community types Monitor fire regimes and effect on vegetation Track insect and disease presence during forest dieback
			Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Consumers	Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Cave Systems Community Monitor changes in cave communities
		Freshwater Ecosystems	Producers Monitor community composition, structure, and productivity
			Community Monitor community dynamics, structure, function, and composition
			Monitor disease incidence and impacts, especially on native species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
	Marine Ecosystems	Benthic	Landscape Monitor patterns of distribution & extent of community types
			Community Monitor community dynamics, structure, function, and composition
			Population Track community and population trends in harvested fisheries / collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Community Monitor community dynamics, structure, function, and composition
		Water column (motile)	Track community and population trends in harvested fisheries species Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor occurrence of non-established (incipient) invasive species
			Community Monitor community dynamics, structure, function, and composition
			Track community and population trends in harvested fisheries collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
		Intertidal	Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species